# ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY
INTERVIEW WITH
GEORGE PALO

BY - CHARLES W. CRAWFORD
TRANSCRIBER - SHARON HESSE
ORAL HISTORY RESEARCH OFFICE
MEMPHIS STATE UNIVERSITY

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# ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY

## INTERVIEW WITH GEORGE PALO

OCTOBER 22, 1970

BY CHARLES W. CRAWFORD

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ORAL HISTORY RESEARCH OFFICE

MEMPHIS STATE UNIVERSITY

PALO, GEROGE P.
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PLACE Knoxville, Tenn.

DATE Oct. 22, 1970

x George P. Palo
(Interviewee) George P. Palo

Charles W. Crawford
(For the Mississippi Valley Archives of the John Willard Brister Library of Memphis State University)

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THIS IS THE ORAL HISTORY RESEARCH OFFICE OF MEMPHIS STATE UNIVERSITY. THIS PROJECT IS "AN ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY." THE PLACE IS KNOXVILLE, TENNESSEE. THE DATE IS OCTOBER 22, 1970, AND THE INTERVIEW IS WITH MR. GEORGE PALO, FORMERLY WITH THE TENNESSEE VALLEY AUTHORITY. THE INTERVIEW IS BY DR. CHARLES W. CRAWFORD, DIRECTOR OF THE MEMPHIS STATE UNIVERSITY ORAL HISTORY RESEARCH OFFICE, AND WAS TRANSCRIBED BY MRS. SHARON HESSE.

CRAWFORD: Mr. Palo, I suggest we start rather informally, if you like, by summing up your experience before you became associated with TVA. You might start at the beginning and go through education, experience or anything you want to add to that.

PALO: All right. I grew up in Superior, Wisconsin, went to elementary and high school there, and then went directly to MIT in Cambridge, Massachusetts, going there in the fall of 1924 and taking a Bachelor's degree in '28 and Master's degree or graduate work in the following year. Scrub that Master's degree; I didn't write a thesis. I studied civil engineering with a special option on hydroelectric engineering. After MIT I went directly to New York City, and for about three years I was doing hydroelectric design at Electric Bond & Share Co., handling both domestic and foreign projects. By 1932 the depression had practically wiped out that kind of work, and I was unemployed for awhile; minor amounts of work at Cooper Union, and then went to

work in the paper business with West Virginia Pulp and Paper Company in New York City.

I always have felt that I might have been one of the first ever to make a written application to the TVA because in the first 100 days of the Roosevelt administration I liked the TVA idea. I've always felt that my interest came from the notion that in New York at that time they were talking about the regional development of the highway system around New York, and here was the suggestion of a regional development of the water resources of a region, or perhaps in those days I would have said the regional development of hydroelectric resources. And I actually wrote a letter of application to the TVA before the act was passed. About a year later somebody found my letter and sent me the formal application form, and some six months later, in December, 1934, I reported to work here.

CRAWFORD: When did you make that application to TVA, Mr. Palo?

PALO: Well, that first letter I would guess was written in April of 1933. But there was no TVA at the time, and, again as a guess, I probably sent it to the Department of the Interior or maybe the Bureau of Reclamation because those were the governmental offices with which I at that time was familiar which might be doing that kind of work.

CRAWFORD: And the letter did get referred to TVA in some way?

PALO: The letter obviously got referred to TVA, and it was, I think, about June of 1934 that the TVA wrote, sending a formal application form, and then it was about the first of December of 1934 that I received an offer to come down here.

CRAWFORD: Who was doing the recruiting for TVA at that time, in '34?

PALO: I actually don't know. I knew nobody here. I remember certain of the names of the people that I first met. I think I had my first interview with George Slover, but I don't presume that he in any way had anything to do with sending me an offer.

CRAWFORD: You arrived then about December of 1934 in Knoxville?

PALO: That's right.

CRAWFORD: Was this your first experience in the South?

PALO: First time I'd ever been south of Washington.

CRAWFORD: What were your impressions of the valley area when you first arrived?

PALO: Well, as far as the general valley area was concerned,

I was immediately pleased with being as close to the mountains as we were, although the Smoky Park had not even been formally dedicated at that time. I enjoyed the climate, except in July and August, when it was too hot, and that still is a part of my feeling.

As far as the city was concerned, it was a city of size comparable to that in which I had been brought up. The sorts of housing that I encountered were far less solid, of course, than the housing that I was familiar with in my home city where the temperatures were frequently as much as 30° below zero, but I rather quickly found a reasonably satisfactory place to live. However, the city itself--and this was in the winter--the air from the soft coal furnaces was practically unliveable, and my wife who was a native of New York City said, "I'm not going to live in the city; I'm going to go out on a farm." So within a month after we got here we found a house about nine miles from the center of town--a house which had never been lived in--actually built for retirement by a railroad man here--and lived there the first year.

By that time we knew that we liked the country; thoroughly enjoyed it, thoroughly enjoyed the people that we were meeting in the TVA, but found the basic city far too conservative for our line of thought. Actually, I had moved from Wisconsin to Massachusetts and to New York without noticing particularly a change, but the move to Knoxville was a change of general feeling on the part of the people. And literally each evening after I went

home after work for a number of weeks my wife and I would exchange stories of the differences that we were finding here from where we had lived before. Those differences were not, by any means, all critical; very often they were happy stories about the gentleness and kindness of the people and so forth. I think the balance was obviously that way, otherwise we wouldn't still be here today.

CRAWFORD: What about the need for development of resources in the valley; what did you think of that at the time you arrived?

PALO: Well, of course, there had been very little resource development. One of the things that I had read of before I came here was land erosion, and I often wondered whether this was just a political football. But when I came here to Tennessee I said, "Now, this really is a case of seeing what land erosion will do." Of course, the Tennessee River had absolutely no values in it with the exception, of course, of a little bit at Wilson Dam and Hales Bar Dam. And other than typical sort of things that are done around the United States where we cut down the forests and have a little mining, that seemed to be about all that was done here. Farming was, of course, at a very low level of skill.

CRAWFORD: And quite depressed at that time, I know, too.

PALO: Oh, yes.

CRAWFORD: What was your first work when you arrived here?

PALO: I was put into what, for all terms, better be called the Design Division and put to work on the design of the Pickwick Dam, which was the first dam that the TVA staff had designed. The Norris and Wheeler Dams were already under construction, but this was done in order to get some work going so that employment could be offered, and the designs for those dams were made by the Bureau of Reclamation in Denver. Pickwick was the first which was designed by the TVA staff. At that time there were about fifteen men, I think, who were working on the Pickwick project, and I went to work on that and was on it for nearly two years.

CRAWFORD: Did you follow the same general plans as the Bureau of Reclamation dams, or did you try anything new in Pickwick planning?

PALO: Well, the basic method of design of a dam of that kind is not very different, whether the design is done by the TVA or Stone and Webster or the Bureau of Reclamation. As a matter of fact, the people who were here were men who had been working for those organizations. The last job of consequence built in the United States prior to Pickwick was probably the Safe Harbor job up in Pennsylvania and maybe the Rock Island job out on the Columbia River. There were a number of men here from Safe Harbor.

The real development in the design of TVA--now, this is the design of the projects--was the bringing together of people from all over the United States and sort of melting together their ideas to come up with what might be called, in my feeling, a better way of accomplishing the kinds of things that most organizations involved in this work were doing. It was a method in which everyone involved was given a chance to make sure that each part of a project was right. And I have always felt that that method resulted in projects which, in their final completion, looked as though they were better planned and designed than many of the projects you see in the United States.

CRAWFORD: How was the coordination of all the different parts of that dam planning done?

PALO: In the beginning the design work was laid out for different groups. For example, as I've already commented, Pickwick was the first, so there was a Pickwick project design group and a Hiwassee project design group, and then came Guntersville and Chickamauga. This procedure, however, runs into difficulty because, for example, let us say, you assign an outstanding electrical engineer to the Pickwick project; then the people who are working on Chickamauga are anxious to get his knowledge. So, it took TVA until the middle of 1939, as I remember it, to change that system and a system was then adopted which has

fundamentally been used until today in the Design Division. This was to put all the civil engineers into one group, all of the electricals into another, the architects into a third, and the mechanicals into a fourth. Then as each project was authorized, a certain staff group would be responsible for that project. That particular staff method has been modified over the years. But that staff group would then get men from each of the four principle design groups to turn out the drawings. And as the drawings were prepared--for example, if a drawing was prepared in the civil design sections, it would be, as the term was used, squad-checked by the architects, mechanicals, and the electricals, so that each of them had the chance to be sure that what one group was doing was satisfactory to it. And this particular system called squad-checking was developed in great detail; and, I think, has been perhaps as a procedural method the biggest contribution TVA design has had.

CRAWFORD: Were there any handicaps with this plan of squad-checking? Did it increase the amount of time necessary?

PALO: Yes, it certainly did make some increase in the amount of time, at least in the Design Division. But one of the elements in the picture here is that the money spent in the Design Division represents somewhere around five percent of the total cost of the project. In fact, on those

earlier hydroelectric projects it was sometimes down to less than two percent, so a small increase that was spent in the Design Division might easily be repaid many times in simplifying construction or making sure that construction did not run into a difficulty which would then have to be corrected at considerable cost.

CRAWFORD: Was this system tried for the first time then by TVA?

PALO: To the best of my knowledge, yes, at least to this degree. The basic system of using four principle divisions, breaking them down to civil, mechanical, electric, architectural, is not unusual. But the care in which this cross-checking procedure was developed was, I think, a unique step.

CRAWFORD: Now let's see, did that start with Pickwick or did that start at a later project?

PALO: Well, in the first couple of years things moved very slowly. In fact, for us younger fellows we were very often quite concerned that we couldn't get a final yes or no to our ideas. But fundamentally, I think, this was the problem of putting a new organization together; taking the ideas that were coming in from men who had worked for different organizations in

different sections of the country and ironing them out to a point where they knew exactly what they wanted to do.

Pickwick was perhaps the real melting pot on these ideas, and by mid-1939 these problems had been ironed out. There had been some changes of personnel; new men had come in who were helping on these problems. So, that after that first couple of years--perhaps that's a little more than two years. It's from 1934 to the middle of 1939--almost four years to get things moving in a really smooth manner. But once that was done, things could go fast and at a very modest cost.

CRAWFORD: How long did you do this same work in which you started for TVA?

PALO: I was in what was called the Civil Design Branch, which was basically involved in the layout of projects and then the concrete and the earthwork really until I went into the Navy in the spring of 1944. So that was nearly a ten-year period. Fortunately, I was given increasing responsibilities during that time. For a certain period I was particularly assigned to what was considered to be special analyses of problems, so that I got into some of the most interesting design problems that were developing in the civil engineering field.

CRAWFORD: What are examples of the sort of problems that you dealt with?

PALO: Well, for example, on Pickwick the question came up as to whether that project should be designed to resist earthquake. And it was decided by our board of consultants that the projects in the western part of the valley should be designed for earthquake because of the fact that they were within the area which was affected by the famous New Madrid earthquake of the 1812 period. So Pickwick did have earthquake analysis on it, as did the Kentucky project. And I think for those days some of the things that TVA did on earthquake analysis and the way we put our projects together were ahead of what was going on in the rest of the country.

CRAWFORD: How did you build earthquake preparation into the dam?

PALO: The problems will vary. If it's merely a massive gravity dam, such as--well, Norris is a better example than to try to go down to the Pickwick job. There you merely add a horizontal force to add to the normal water pressures on the upstream face of the dam, and in effect, you design a larger, thicker cross-section than you otherwise would. But when you get to a project such as the intake at Pickwick, which is simply a large block of concrete in this particular case with large openings through it for the water to flow through, here you run into problems of vibration where the answer is obtained by deciding how much reinforcing steel is necessary. So, your earthquake will require

you to put in additional reinforcements. These are perhaps oversimplifying our answers. When you get into a retaining wall--and here we did a great deal of work--the Kentucky project had a very high retaining wall to hold back earth, and here now was the question of how the shaking of an earthquake would affect the manner in which the earth pressed against the concrete retaining wall. Here we did certain model testing, as well as mathematical approaches, worked with Professor Jacobsen at Stanford University, both as a consultant and at making model tests, and came up with our ideas of how we would design that cross-section.

I might also add--changing the subject a bit on certain specialties--we were moving quite effectively on the way of taking care of the changes in volume that you get in a concrete structure because of the fact that the chemical action of the setting of the cement releases heat which heats the concrete and then when it cools off again it can crack. And the engineering techniques, the understanding of what goes on and then the techniques to take care of that were another one of the problems that we worked with quite effectively, I believe.

CRAWFORD: What about this board of consultants? When was the board created? Do you know whose idea it was?

PALO: No, I can't answer specifically whose idea it was,

although I would guess probably that Arthur Morgan, who was, of course, the first chairman of the board and was an engineer, probably was responsible for that. It is not in any way an unusual procedure; it's a quite normal procedure that a large design organization, such as was the TVA, has a board of consultants who come in at intervals and inspect work that's going on, generally are asked certain questions and give their answers to those questions to generally approve both the methods of design and of construction. That's not a great deal of work. TVA publishes the individual reports of the board of consultants, and perhaps on a specific project that might have taken five years to design and build there maybe were perhaps eight or ten consultants reports. However they can be very, very important contributions to a project.

CRAWFORD: Did you consider them helpful in the design work of TVA in this period?

PALO: In the very early parts of my work here I was not in a position where I was in direct contact with the consultants. But certainly--we've been talking about Pickwick and earthquake there--they actually, by saying, "Yes, we'll design for earthquake in certain areas and not in others," set the TVA policy. Later, perhaps by about 1940, I was beginning to work directly with the consulting board when they came in, or at least I would be a part of the party which was involved, and

they very often made some very valuable suggestions. John Savage, who at that time was the chief engineer for the Bureau of Reclamation and considered to be maybe the outstanding dam man in the entire world, was a member of that board, and I remember particularly that I think it was basically his ideas that were used for the design of the earth and rock sections of the Cherokee Dam, which was started about 1940.

CRAWFORD: Who was Chief Engineer at the time you came?

PALO: I think that Arthur Morgan still retained that title. He was the Chairman of the Board and Chief Engineer.

CRAWFORD: Who became Chief Engineer then, Carl Bock?

PALO: Carl Bock followed after that.

CRAWFORD: Was succeeded by Colonel Parker?

PALO: Yes. And in my opinion, Colonel Parker was a very, very important individual for getting the TVA into the high standard that it reached.

CRAWFORD: Where did Carl Bock go after he was replaced as Chief Engineer?

PALO: I know that he spent considerable time in Puerto Rico, but I'm not sure that that was the only place.

CRAWFORD: He is dead now, isn't he?

PALO: I think so. His son-in-law, I believe, is still living up around Morristown.

CRAWFORD: And when Colonel Parker left, was he succeeded by Clarence Blee at that time?

PALO: Yes.

CRAWFORD: In your early career with TVA, I believe you had a ten-year span within engineering design, didn't you; then you went to the Navy in '44?

PALO: That's right; that is, I was in the Navy from about March of 1944 until December of 1945. The situation that developed, as far as I was concerned at that time, involved Mr. Meyer, who was the head of what was our Civil Design Branch. At the time I went into the Navy, I was his immediate assistant. At the peak of the wartime period, about 1942, that Civil Design Branch involved nearly 200 men. In 1945 Mr. Meyer had some problems with health, and when the war came to an end he asked

the TVA for leave, and TVA organized to get me out of the Navy earlier than my points would otherwise have done, and I came back and became head of what was the Civil Design Branch in 1946 or right at the end of 1945.

CRAWFORD: Did you anticipate returning to TVA at the time you left to go to the Navy?

PALO: Yes, I wouldn't say that I didn't look at other possibilities, but I didn't ever really make a serious effort to because I thought the TVA still had lots to do, and it was an interesting place to be.

CRAWFORD: Pardon me, sir. Go ahead.

PALO: I was going to say relative to that that while I was in the Navy I was in Washington, and Joe Swidler, who was later our general counsel, was also there. Towards the end of the war there seemed to be in the TVA a feeling of pessimism relative to its basic design and construction program. The thought was that the construction program was largely over, and that from there on the project was going to be a matter of operation. Joe and I used to sit together in Washington and say, "What on earth are they talking about down there? The way things are developing, just in order to meet the power requirements there is going to have to be a very major program in future years." And in 1945, I remember our talking together and, of course, in the early part of the war we

had built our first steam plant--the Watts Bar Steam Plant--and, as I remember the conversation, I said to Joe, "TVA is going to have to build another steam plant by 1950." And Joe said, "It'll come before that."

CRAWFORD: Were you working on steam plant design before you went to the Navy?

PALO: Basically, no, although I'd had a little touch of it. I really was principally in the hydro work rather than the steam plant work.

CRAWFORD: Did you foresee a shift to steam plant rather than hydro-power source?

PALO: Yes. Anyone who has been in the power business knows that if you happen to live in an area which has a hydroelectric potential, the first thing that is developed is the hydro. But after a certain number of years the hydro is all used up and there is no section in the world where the hydro potential will take care of the ultimate demand. And when you finish with the hydro then you must go over to steam within the modern technology. So, there was no question about somebody having to build steam plants down in this area. It just was how much and when.

CRAWFORD: You had a tremendous increase in demand for power in the early forties as a result of the war.

PALO: Yes.

CRAWFORD: And that was met mainly through steam plant building, wasn't it?

PALO: Not in the early forties, no. Power demand was going up. Measured by today's figures, it was puny. I always felt that this was some of Mr. Lilienthal's foresight--I may be completely wrong there--but he asked for the Watts Bar Steam Plant in 1939, and it was first authorized with two units, with a total capacity of about 120,000 kilowatts. In the latter part of the war two more units were added, so that the plant was completed with 240,000 kilowatts.

CRAWFORD: That's still a low pressure, low temperature plant, I believe, wasn't it?

PALO: In today's terminology, yes. But of that particular time it was what might be called a modern unit. It was not one that was breaking ground for new types, but it was quite a modern and efficient unit. In fact, there are people today who say well, if they had the Watts Bar Steam Plant on their system, they would be quite happy to use it. But the demand

that came through from the Atomic Energy Commission during the war was met by a combination, of course, of Watts Bar and of hydro. In fact, I think it's been more or less standard to say that the Fontana project was what took care of Oak Ridge in those days. Fontana had only about 150,000 kilowatts in the first two units. Then, of course, the growth that began in the postwar period, spurred on by the actions in Korea and the growth of the Atomic Energy Commission, that from about 1950 to 1956 introduced a tremendous increase in demand, looking at it on the basis of a percentage increase of the system annual increase.

CRAWFORD: When you returned from the Navy how did you find things changed from the time you had left? What had happened during that gap?

PALO: Well, even before I left to go to the Navy, because of the war effort and the idea, of course, that building a power project is a job of several years and therefore something that shouldn't be really done during the war, the Fontana project just scraped by the approval of the War Production Board. By the end of the war or let's say by even early 1944, TVA's engineering work was dropping off very extensively. So when I came back at the end of 1945 the biggest problem for the administrative people in engineering in 1946 was how do you handle the men who are returning from the service and who have a right to

come back to their jobs. We studied our work load, and very often our man who watched our schedules would come in and say, "George, we've got three months work left." And this isn't exactly much of a backlog when you have a lot of men who are coming back from service.

CRAWFORD: When did that situation change?

PALO: It really scraped along that way for--perhaps not quite that bad--but it really didn't get good until about 1949. Actually, soon after the war, as I remember it, we got the go-ahead to work again on the Watauga and South Holston projects, which had been stopped by the War Production Board. And we had some other cases of adding units at existing power houses and so forth, so really by 1947 we were getting onto a good keel again. The men who had gone to service had either come back or were not coming back. And, as I remember it, certainly by the graduating classes of 1948 we were hiring new, young engineers. Then when the Johnsonville Steam Plant was authorized in the spring of 1949, as I remember it, from there on for the next several years things were just increasing at a great rate.

CRAWFORD: Your work was almost altogether with steam plants, I believe, in the fifties, wasn't it?

PALO: Yes, very nearly so. There was very, very little

hydro work, relatively speaking. Of course, there were two elements at least in that. One was that the hydro capacity from the point of view of power had been practically used up, so we had just now reached the stage that we were talking about earlier, that you could foresee that you had to go to steam. That came by 1950. And the other element was that under the Eisenhower administration there was considerable concern about the activities of the TVA. I was not close enough to the budgeting procedures; I don't really know what the TVA requested, but the appropriations were very scant. There was at least one occasion where it was only a very last minute change of heart in Washington that gave enough money for some of the relatively key but small parts of the TVA to continue to work.

CRAWFORD: What was the size of the department when business leveled off again about 1948? Approximately how many engineers were involved?

PALO: If we talk about the entire Division of Design, as by this time it was pretty well known, my memory may be off at this point, but I think that by sometime in 1948 we were probably running between 250 and 300 people. We were growing and, as I indicated a few minutes ago, in the early fifties we grew to our peak at that particular time. And I think that by about 1954 the organization had grown to something around 600 people.

CRAWFORD: Where did you recruit your new engineers mainly in the thirties and then in the forties?

PALO: Well, in the thirties, of course, if you go back to the very beginning, we were still in a period of depression, so that the TVA had an opportunity to pick and choose pretty much from an extremely large and well qualified number of applicants. But as the years went along, by 1940 things were getting better; we were beginning to get more of our men as just college graduates largely from many parts of the country. But by the time the postwar period arrived it became, and still exists that way, a situation that most of the new men were coming from southeastern schools, a situation which I personsonally always tried to change as much as I could simply because I feel that the greater spread that you can get among your people, the more different ideas you'll have.

CRAWFORD: Well, it's certainly true in the early period, wasn't it?

PALO: That's certainly correct.

CRAWFORD: What did you think of the quality of the engineering staff in general during the early days of TVA?

PALO: Well, there's no question that simply because it was recruited at a time when practically all of the hydroelectric engineers had been out of work, they were able to recruit a very highly qualified group of people.

CRAWFORD: Where had most of the hydro engineers who worked in the early period had their previous experience? Had it been with the Corps of Engineers, Bureau of Reclamation, private corporations, in foreign countries, or where?

PALO: Well, although I don't have any real statistics on this, I would guess that far and away the greatest number of people who came to work for the TVA, let's say before 1940, had had their experience in private corporations. Many of those were in New York, but there were organizations such as Stone and Webster in Boston. There was Pacific Gas and Electric Company on the coast. There was one organization at least over in Charlotte, North Carolina which was designing hydroelectric projects, which formed the company that then became the Duke Power people, and, as I mentioned earlier, there was the Safe Harbor job which was being designed by people in Baltimore.

This doesn't mean that there weren't a certain number of engineers who came in from the Corps, but the Corps' experience at that particular time was not especially in the kind of work that the TVA was doing. It fell on somewhat smaller dams and in

rivers and harbors. And the Bureau of Reclamation, of course, had been designing the high dam sort of project, but generally speaking, most of the men who were working for the Bureau of Reclamation certainly just liked it out there, I imagine, and stayed there.

CRAWFORD: Did you have much interchange of personnel between TVA and private engineering firms? Did your engineers leave to go to work other places occasionally?

PALO: Oh, yes. There were times when they more or less had to leave because our work dropped off. Over the years I used to say that we had about a ten-year cycle between one high level of employment to another. For example, historically, I believe, the engineering staff built up until 1939; in 1939 there were some layoffs. Then in came the war work and layoffs were regretted; they were almost cancelled, but then we had to go looking for more people. Then there was the drop-off at the end of the war. Then perhaps one of the most interesting ones was the drop off that occurred in the mid-fifties, after the first surge of steam plant construction. I remember that at that time we had about 600 people, and we told the men in what I remember to be about the first of January, that by the first of July we would have to be down to 450. Because of voluntary resignations, when the first of July came I think the figure was somewhere around 465, so the

actual number of layoffs was practically negligible, but this is typical in design work in engineering. It just does go up and down. Basically, however, I think it can also be said that the rate of turnover in TVA--at least when I compare it with any other experience that I've had--is very low. However, over a period of thirty years, you have a lot of men leave you for one reason or another.

CRAWFORD: Could you predict the low points when you have a light load of work in engineering design?

PALO: No, I don't think you can exactly. I think you can see them coming perhaps two or three years in advance. You certainly know that in the ways things are arranged. If you don't get new work authorized, then you know you're going to drop off.

CRAWFORD: It is tied to appropriations, of course.

PALO: That's right. Or, of course, under the current system, as far as the work we've been talking about at TVA, which is the work of the engineering design people, it is overwhelmingly decided upon by the amount of power which is needed. Now, whenever I've talked to people over the years about TVA I always point out that although power has taken, by far,

the greatest number of dollars and, at least as far as engineering is concerned, the greatest amount of manpower, it is only fair to say that the other work of TVA has always been given very high priorities. And the engineers who have been needed to handle flood control problems, navigation problems or any of the many other problems involving water--those jobs have always been done. But when you try to look at how many men you're going to need, the basic answer to that is decided by what your power program is, and that is particularly so at the present time.

CRAWFORD: What changes took place during the 1950's in your design work?

PALO: Well, the 1950's was a period, as we've already said, where design--and I think by now we can begin to talk about construction as well. I'm beginning to get to a period where I personally began to get involved from the construction side too, or least have administrative responsibilities for that towards the end of that decade. This was a period of steam plant construction, and at the beginning we were building large plants but not plants which could be said to be particularly unique. That is, for instance, Johnsonville with units which generally are spoken of as 125,000 kilowatt capacity (officially, I think they were 110,000 kilowatt). There wasn't anything special about those units in size, pressures, temperatures. If anything, the

unique element was to say, "Well, we're going to put ten such units in one plant," which would have been somewhere around a million and a quarter kilowatts. That had not been done up until that time. This was an element which was an area of discussion among engineers because there were some who felt that was too big, that plants of that size would not be developed within a reasonable economic period. Of course, when the Shawnee job came along, which was authorized along about 1951 and had ten units put into it very quickly, the idea that large plants was a standard thing was accepted. But as the years went along and the TVA steam plant program continued at the rate that it did, we kept increasing the sizes of the units until finally, just to jump over some other areas, about 1957 or '58 as I remember it, we were at a position of asking the manufacturers what was the largest size unit that they would build for us. And they said, well, they would give us something of 350,000 kilowatt capacity. We said, "No, we think we ought to have something bigger than that." In fact, we kidded them a little bit. We said, "How come you can only give us 350,000 kilowatts when they've already ordered a 500,000 kilowatt unit in England?" So, actually when we sent out bids for these units we had had no commitment from the manufacturers as to what they would bid on, so we gave alternatives to bid on either a 350,00 kilowatt unit or a 500,000 kilowatt unit; at least that's the way I remember it. And then the manufacturers did, at least two of them, bid on the 500,000. Now that was really the beginning of the time when, from there on, practically

every unit that TVA added to its system was a first of its kind. Generally it was the first because it was the biggest, and here then we were moving out to develop the techniques necessary for those large units.

CRAWFORD: You kept increasing the size of the units through your steam plant building?

PALO: Yes, and as you probably know, (I may even be out of date by now myself because these things change) but we moved up to a size so that now at the Cumberland Station, which is the conventional steam, the unit is 1,300 megawatts capacity. In other words, it is approximately ten times as big as the units which went into Johnsonville twenty years ago. As far as steam pressures are concerned, we were not the leaders in this; that is, the so-called super-critical level, which is about 3,500 pounds per square inch, was introduced by other utilities around the country before we adopted it for the first time.

CRAWFORD: What about the change now to nuclear plants as a source of power production? When did that start; when did you first anticipate it?

PALO: Well, the TVA started to think about it, as I remember, probably about 1956. The men in the Office of Power under Mr. Wessenauer said that they wanted to

set up a small group to keep abreast of the development. At that time the Shippingport project, which was the first real commercial power station, was under construction outside of Pittsburgh. The procedure to get those first TVA nuclear people was to publicize within the engineering offices our interest in that, and if a man felt that he wanted to get into that work, he was asked not only to apply for it, but as I remember it, to write an essay--at least a short paper--on why he wanted to do this. And a certain number of men were chosen. There was some talk in TVA that we might authorize a nuclear power plant as early as 1958. Personally, I never felt that that could happen. The years went along, and nuclear power, of course, had its ups and downs, and then, of course, along about 1963 or '64 the Oyster Creek job in New Jersey was contracted to General Electric at a price which was fantastically low. We were still working on these things, and we were working on it before Oyster Creek was authorized. Research groups out at Oak Ridge wanted to do some thinking on the nuclear end and wanted some help on what might be called the conventional end of a nuclear station, so at any rate, we always kept working on it. Finally about 1964 things began to look very favorable. And, as I remember it, we reported to the board at that time--the TVA Board--that we felt that things were sufficiently favorable to justify expanding the study and continuing. They said to go ahead, and we did that, and by "we" in this particular case--most of this work had to be done by the engineering offices

in Knoxville and the Office of Power people in Chattanooga. It was a combined effort. And as a result of those studies we finally decided to take an invitation to bid for a nuclear station which became the first units which were awarded for the Browns Ferry nuclear job, which as I remember it, were awarded sometime in 1965 and '66.

CRAWFORD: What about anticipating power needs? Did you keep relatively accurate in your estimate of developing power needs?

PALO: The estimating of power needs is the responsibility of the Office of Power in Chattanooga, so they, of course, answer that question officially. However, as a matter of just interest, I always kept tabs of their estimates which they made for maybe four or five years in advance, and they were pretty good.

There was one period in the early sixties where they generally were running a little ahead; they may have estimated a little too much. This is not criticism; it's merely a matter of fact. When somebody's trying to estimate that you may increase 8 percent per year, if it turns out to be 7 percent, why it's too much, but it's still a pretty good estimate. So that I would say that the estimates of power increase have been very good. This can be backed by the fact that we have had (I think I remember correctly) only one time in the history of TVA

where we actually slowed down the power construction program because we were going to have more power available than we needed. And that was in the early part of the 1960's or about the mid-1960's when we actually delayed the start of construction of the Bull Run Plant by about a year and slowed down the Widow's Creek number seven unit, which was already under construction. We've had plenty of times when we've been fighting to get the power completed because the demand was already there. This incidentally arises because you can put a nuclear enrichment plant such as Oak Ridge or Paducah--you can build those faster than you can build a power plant. So, if the Atomic Energy Commission came in and said, "We're going to build an addition to our system and we want you to build a power plant to provide the power," there was always that gap that they could build their system faster than we could build the power, and then you were always fighting to have enough power available.

CRAWFORD: There's been a tremendous increase in demand, certainly in the 1960's. What sort of design work did you do in your last years with TVA?

PALO: Well, let me fill in here that at the end of 1946 Mr. Meyer, whom I have already mentioned, came back after a year of leave and at the same time, Mr. Kenneth Roberts who was in charge of another part of the design work and had a corresponding job, resigned. I took Mr. Roberts' job which was

to be responsible for the design of the structural steel, the bridges and the, what we call, heavy equipment--that's such as cranes and coal handling systems and so forth. I held that job as the head of that branch for about ten years and then I was obviously being shifted for my final job. I became Assistant Chief Design Engineer and then Assistant Chief Engineer in 1958 and '59, and then in 1959 I was made Chief Engineer. That, of course, gave me a responsibility for both the design and the construction.

CRAWFORD: Did your work as Chief Engineer take you away from the close engineering work you had done before? Were you able to keep up with that or did administration occupy your time a great deal?

PALO: Well, you'd have to say that administration took the major portion of the time; that is, when the work had now moved away from the hydroelectric field into the steam plant and then the nuclear plant field. I once upon a time perhaps claimed a certain amount of expertise technically on hydroelectric work, but I would never choose to do that on the steam plant type of work, either the coal-burning or the nuclear, though I always did try to keep abreast of the technical side of it. I just didn't have the time to get into the details of it.

CRAWFORD: I suppose you learned a lot more about general engineering but less about specific things you specialized in earlier.

PALO: Exactly.

CRAWFORD: What was your work at the time of your retirement?

PALO: Well, they made some modifications of organization in 1963, and at that time my title was changed to Manager of Engineering Design and Construction, so from '63 until I retired in the middle of 1969 I had reporting to me the Division of Design and the Division of Construction. And, of course, that was the period where we continued with the coal-burning stations; we introduced the nuclear stations and we did begin to get back into more water resource work. I won't call them hydroelectric stations because they weren't that; they were water resource developments. They weren't large by any means relative to the rest of it, but there was more of it going on in the sixties then there was in the fifties.

CRAWFORD: Did you travel a great deal in this administration, or were you able to handle most of it from the office here?

PALO: Well, I don't know exactly what you would mean by a great deal, but domestically there would be three elements. One was to try to get out to the construction projects themselves--perhaps try to visit each project maybe once every three months. I don't know that I made it that frequently. There would be travel under certain kinds of circumstances to contractors plants. For example, when we let the nuclear contracts it was necessary to be in California a couple of times at San Jose where the General Electric was doing nuclear work. And then in that last work there was a certain amount of membership in national and international organizations which would call for travel to a modest number of conventions. And we also, as I'm sure your've heard, developed international contacts both with manufacturers who came mostly from Europe and also by the international contacts with power operating organizations in England and France and so forth. Because of that there were two or three or four occasions where I traveled to those countries on business. And one final one, close to the end of my work, I got over to Russia for a couple of weeks. That was a very fascinating experience.

CRAWFORD: I'm sure that it was. Did you have an opportunity to examine engineering projects over there?

PALO: Incidentally, Mr. Wessenauer went on the same trip, and both of us felt that we would be of most use to

the TVA to examine not so much their engineering projects as their projects where they manufacture their large generators; their plant where they manufacture their large turbines, both hydro and steam, and also to a cable plant and also a very large transformer plant.

CRAWFORD: How did you find their technology compared with that of the Americans?

PALO: Pretty good. Don't ever consider that they're not very, very close to us; in some things they're ahead.

CRAWFORD: Of course, they've had a lot of experience in hydro work over there.

PALO: That's right. They've built bigger hydro units than we have. I don't, however, feel that when somebody says it's bigger, that that is necessarily something of a great compliment. To build something big just because you want to be big is fundamentally wrong, but with their very large rivers and so forth they had good reasons for going to large sizes, and so they had done unusual things in that respect. In the sizes of units, they were behind us as far as the sizes of their steam power units were concerned, but they were moving

along. And in their transmission, with their very huge country, and where they want to transmit power from the Siberian end of it over in to the European end of it, they had some long transmission lines, and in some of those respects, although this is not my field of specialty, they've done things which we have not yet done--or I believe we are just beginning to do them in California with some of our direct current transmission.

CRAWFORD: What year did you retire from TVA, Mr. Palo?

PALO: I retired at the end of June, 1969. I thought that by that time I had been working for about forty years and my personal feeling was always that I wanted to retire when I was sixty, and by that time I'd hit sixty-two, so I was already about two years late.

CRAWFORD: Do you have any parts of this that you'd like to include that I haven't thought to bring up?

PALO: Well, you've covered this pretty well with your questions and letting me run on here. I can only perhaps best summarize it by saying that if I had felt that there would be something more interesting in engineering for me somewhere else I would have gone. I wasn't wedded to this area. I like it, but I could easily have moved somewhere else.

I will say that I didn't particularly cotton to the idea of ever working in a foreign country. By this, I mean the Asiatic areas and so forth, so I wanted my work to be domestic, and I just never saw a situation that interested me more than being right here. From an engineer's point of view, for those who are interested in the power business, it still looks like a very good place to be.

CRAWFORD: Well, this is certainly where things have been taking place in the type of engineering that you were doing. Thank you very much, Mr. Palo.